

## On the genus *Cycloscala* Dall, 1889 (Gastropoda: Epitoniidae) in the Indo-Pacific, with comments on the type species, new records of known species, and the description of three new species.

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**KEYWORDS.** Gastropoda, Epitoniidae, *Cycloscala*, Indo-Pacific.

**ABSTRACT.** All described Indo-Pacific taxa referable to the epitoniid genus *Cycloscala* Dall, 1889 are listed and evaluated. The type species, *Cycloscala echinaticosta* (d'Orbigny, 1842) is discussed. Four described Indo-Pacific *Cycloscala* species, considered valid herewith, are treated: *Cycloscala crenulata* Pease, 1867; *C. gazae* Kilburn, 1985; *C. hyalina* Sowerby II, 1844; and *C. revoluta* Hedley, 1899. Three new species are described: *Cycloscala armata*, *C. sardellae*, and *C. montrouzieri*.

### INTRODUCTION.

#### Background information.

This is the third part of a study of Indo-Pacific Epitoniidae in which extensions of known geographical ranges of a number of species and the description of new species is reported (García, 2003, 2004). The present article deals with epitoniid species placed in the genus *Cycloscala* Dall, 1889. The material used in these reports was obtained as a result of expeditions by the Institut de Recherche pour le Développement (IRD, Nouméa) and the Muséum national d'Histoire naturelle (MNHN, Paris).

Background information on the expeditions, with narratives of the cruises, station lists, maps, etc. can be found in Forest (1989), Richer de Forges (1990, 1993) and Richer de Forges & Chevillon (1996), Richer de Forges *et al.* (1996, 1999, 2000a and b), and Bouchet *et al.* (2001).

All of the Indo-Pacific material cited in this report, unless otherwise stated, is housed at the Muséum national d'Histoire naturelle, Paris.

#### The genus *Cycloscala*.

When Dall erected the taxon *Cycloscala* he mentioned only two species: *Scala hyalina* G. B. Sowerby II, 1844 and his newly named *Scala (Cycloscala) dunkeriana* Dall, 1889. The new subgenus was instituted to accommodate epitoniids "with the later whorls disjoined and the varices scalloped" (1889: 259); however, Dall failed to designate a type species. Perhaps logically, but unfortunately, de Boury subsequently (1909) designated Dall's taxon, a junior synonym of

*Scaloria echinaticosta* d'Orbigny, 1842, as the type species for the subgenus.

Although the genus *Cycloscala* was originally treated as a subgenus of *Epitonium* by Dall (1889), Clench & Turner (1951), and Abbott (1974), Kilburn (1985) considered the species in this group sufficiently distinct to raise its status to full genus, a treatment that had been effected earlier by Jousseume (1912:195). DuShane (1990) and Nakayama (2000, 2003) have followed Kilburn. Robertson (1994:107) is ambiguous in his treatment.

When Kilburn raised *Cycloscala* to a generic level, he expanded Dall's short description, giving the following diagnosis: "Shell small to minute, later whorls disjunct, axial lamellae erect, usually weakly crenate; protoconch polygyrate, conical, peg-like, with dense, arcuate axial striae visible under SEM" (1985:257).

Whorl disjunctness may have arisen independently in different lines of *Epitonium* s.l., and the genus *Cycloscala* may well be polyphyletic. However, notwithstanding the similarities between some forms of *Cycloscala echinaticosta* and members of the genus *Epitonium*, such as *E. semidisjunctum* (Jeffreys, 1884), I follow Jousseume and Kilburn in treating *Cycloscala* as a full genus.

The most salient differing character between *Epitonium* and *Cycloscala* is the combining traits of scalloped costae and a shell body that lacks spiral ornamentation. A number of species of *Epitonium* s.l. may have crenate or frilled costae, but these characters are always associated with spiral cords or threads; are usually not spinose, except at the shoulder; and the frills or crenulations occur on a plane parallel to the axis of the shell. The "scalloped" costae in *Cycloscala*, a term used by Dall in his original description, is vertical to the axis, spinose in nature and, more importantly, unrelated to spiral cords or threads. These spiral elements are absent on the body of the shell of

all member of *Cycloscala*. Although there are some species of *Epitonium* s.l. which have scalloped costae similar to those in *Cycloscala*, the scalloping forms an integral part of a spiral design; otherwise, the shells are quite dissimilar in structure to species placed in *Cycloscala*.

Some of the forms of western Atlantic *Cycloscala* seem to be the end of a cline with less disjunct whorls and less conspicuous scalloping, while several Indo-Pacific species, in particular some of the material that has just come to light, represent the opposite end of the cline, with completely disjunct whorls and extreme degrees of scalloping unique in the Epitoniidae. This character, in conjunction with the lack of spiral ornamentation and other distinguishing characters pointed out by Kilburn, makes a cogent argument in favor of treating *Cycloscala* at the generic level.

### The type species of *Cycloscala*.

*Cycloscala echinaticosta*, the western Atlantic type species, is most atypical of the genus. In the form described and pictured by d'Orbigny (Fig. 39) it is the least solute of the species of *Cycloscala*, and cannot be differentiated from *Epitonium* species except for having a more delicate shell, slightly more solute whorls, and scalloped costae of differing strength. The latter character is greatly diminished in *Scala electa* A. E. Verrill & Bush, 1900, here considered to be a form of *C. echinaticosta* from Bermuda.

The many taxa placed in synonymy with *Cycloscala echinaticosta* attest to the great variability of the species (see Redfern, 2001: pl. 36; also Figs 1-7). Studies made by Clench & Turner (1951: 253-255) and Robertson (1994) have concluded that they are all forms of a single species. However, although *C. echinaticosta* is unquestionably a variable species, it is yet to be determined whether or not some of these variations (see Figs. 4 and 6) are of an ecological or a genetic nature, as no molecular work has been performed in this complex.

Reports on protoconch whorl count for *Cycloscala echinaticosta* vary from 2.5 whorls (Clench & Turner, 1951; Abbott, 1974) to 3.5 to 5 (Robertson, 1994; Redfern, 2001). Robertson has done a protoconch study of *Cycloscala echinaticosta*, and has concluded that its length, as well as the number of whorls, increases along depth gradients, from 330 to 790  $\mu\text{m}$ , and from 3.5 to 5 whorls. I have examined the protoconchs of eleven specimens from Abaco, Bahama Islands sent to me by Mr Colin Redfern. The count agrees with the reports made by him and Robertson. I have also examined four specimens with protoconchs from the Bahama Islands, Belize, and Bonaire, sent by Dr Harry G. Lee, and they have about 4.5 whorls (Fig. 7). Presumably, Clench & Turner miscounted

the whorls, a common error when working with the Epitoniidae. The protoconchs I have studied are white and peg-shaped. The fresher specimens show incised axial lines, a character that is clearly shown by Robertson's SEM photographs (1994:109).

The large number of Indo-Pacific *Cycloscala* at my disposal show consistency of shape, color and number of whorls on available protoconchs, regardless of species, depth, or geographical distribution, raising doubts that *C. echinaticosta* is a single, variable species. All but one species had a peg-like, amber or yellow-colored protoconch of about 4.5 to 5 whorls; and fresh specimens show the characteristic incised axial lines of epitoniids with planktotrophic larval development.

### Indo-Pacific species and subspecies referable to *Cycloscala*.

There are eleven described Indo-Pacific taxa referable to the genus *Cycloscala*. Of these, I consider five to be valid and six to be junior synonyms. In this work three new species are described, for a total of eight valid Indo-Pacific species, herewith printed in bold letters:

***Scalaria hyalina* Sowerby II, 1844**

***Scalaria crenulata* Pease, 1867**

***Scalaria revoluta* Hedley, 1899**

*Scalaria (Cycloscala) latedisjuncta* de Boury, 1911 (= ***Scalaria revoluta*** Hedley, 1899)

*Scalaria (Cycloscala) paucilobata* de Boury, 1911 (= ***Scalaria hyalina*** Sowerby II, 1844)

*Scalaria anguina* Jousseaume, 1912 (= ***Scalaria crenulata*** Pease, 1867)

*Epitonium hyalinum mokuoloense* Pilsbry, 1921 (= ***Scalaria hyalina*** Sowerby II, 1844)

*Solvaclathrus jacobiscala* Iredale, 1936 (= ***Scalaria hyalina*** Sowerby II, 1844)

*Epitonium (Solvaclathrus) crenulatum dragonella* Kuroda, 1960 (= ***Scalaria crenulata*** Pease, 1867).

***Cycloscala gazae* Kilburn, 1985**

***Cycloscala spinosa* Nakayama, 2000**

***Cycloscala armata* n. sp.**

***Cycloscala montrouzieri* n. sp.**

***Cycloscala sardellae* n. sp.**

Kilburn (1985:257) and Weil *et al.* (2000:88) consider *Scalaria laxata* Sowerby II, 1844 a member of *Cycloscala*. However, Sowerby describes this species as having "simple" varices; and the type figure does not show scalloped costae. Weil *et al.* also consider *Scalaria semidisjuncta* Jeffreys, 1884, an eastern Atlantic species, and *Viciniscala okezo* Azuma, 1962, from Japan, as *Cycloscala*; but these species also lack scalloped costae. Although I had formerly placed "*Cycloscala*" *aldeynzeri* García, 2002 in *Cycloscala* because of its very disjunct whorls. I did so reluctantly, as it has non-scalloped costae and is of a large size for the genus. I now believe "*Cycloscala*" *aldeynzeri* should be placed elsewhere.

**Abbreviations**

MNHN: Muséum national d'Histoire naturelle, Paris.

dd: specimen(s) collected dead.

lv: specimen(s) collected alive.

**SYSTEMATICS**

Superfamily **EPITONIOIDEA**

Family **EPITONIIDAE** S. S. Berry, 1910

Genus *Cycloscala* Dall, 1889:316. Type species (s.d. de Boury, 1909) *Scala dunkeriana* Dall, 1889 [= *Scalaria echinaticosta* d'Orbigny, 1842].

*Solvaclathrus* Iredale, 1936:299. Type species (o.d.) *S. jacobiscala* Iredale, 1936.

***Cycloscala armata* n. sp.**

Figs 8-10

**Type material.** Holotype MNHN length 4.7 mm, width 2.6 mm; 1 paratype MNHN.

**Type locality.** Reunion Island, 21°05'S, 55°12'E, 170-225 m [MD32, sta. DC56].

**Material examined.** Loyalty Ridge. MUSORSTOM 6: sta. DW399, 20°42'S, 167°00'E, 282 m, 1 dd (paratype).

Reunion Island. MD32: sta. DC56, 21°05'S, 55°12'E, 170-225 m, 1 dd (holotype).

**Distribution.** Loyalty Ridge and Reunion Island, 225-282 m (shells only).

**Description.** Holotype 4.7 mm in length, strongly turbinate (width/length ratio 0.55). Protoconch missing. Teleoconch of about 3.25 disjunct, shouldered whorls; first whorl slightly tilted from axis. Axial sculpture of six strong costae; edge of costae conspicuously folded abaperturally (Fig. 9), ornamented with four heavy, almost rectangular denticles, evenly distributed on outer edge of axial costae; denticles obsolete at umbilical area. Space between costae smooth. Aperture circular. Shell stained light-yellow, presumably white when collected in fresh condition. Operculum unknown.

**Remarks.** This appears to be a deep-water species. All the characters of the holotype are shared by the paratype in spite of the great distance between their respective localities. The four strong, almost rectangular denticles of the costae, as well as the conspicuously folded edge, separate this species from other *Cycloscala*. It is closest to *Cycloscala sardellae* n. sp., which has a more attenuated shape, eight denticles at the edge of the costae instead of four, and the edge of the costae are only slightly bent. Some strongly scalloped forms of *Cycloscala*

*revoluta* (Hedley, 1899) resemble the new species, however, the crenules in *C. revoluta* are of uneven strength, are roundish, not rectangular, and are unevenly distributed; and the costae are conspicuously hooked at the shoulder.

**Etymology.** Latin *armatus* [used here as an adj. meaning armed], referring to the heavy, cog-like structure of the axial costae of the species.

***Cycloscala crenulata* (Pease, 1867)**

Figs 11-12, 30, 35

*Scalaria crenulata* Pease 1867:290, pl. 24, fig. 13.

Type locality: Tahiti

*Scalaria anguina* Jousseaume, 1912:195-196, pl. 7, fig. 39. Type locality: Red Sea.

*Epitonium (Solvaclathrus) crenulatum dragonella* Kuroda, 1960:73, pl. 1, fig. 10. Type locality: Okinawa.

**Material examined.** Loyalty Islands. Atelier LIFOU 2000: sta. 1455, 20°56.8'S, 167°02.7'E, 15-20 m, 1 dd. New Caledonia. EXPEDITION MONTROUZIER: sta 1273, 20°50.4'S, 165°22.8'E, 20 m, 1 dd.

**Distribution.** From Okinawa and Hawaii to Tahiti, New Caledonia, the Loyalty Islands, and the Red Sea, 15-30 m.

**Remarks.** Pictures of the holotype have appeared in DuShane (1990:11) and Weil *et al.* (1999: 89). *Cycloscala crenulata* is a distinct, widely distributed, species. However, it seems to be rare and is represented in the material studied by only two dead specimens. It has a characteristic expansion of the costae, not a hook, at the periphery. *Scalaria anguina* Jousseaume, 1912 from the Red Sea matches the description and type photograph of *Cycloscala crenulata*, and I consider it a junior synonym of the latter. *Epitonium (Solvaclathrus) crenulatum dragonella* Kuroda, 1960 (Fig. 35) is also a synonym. The Okinawa specimen was considered a subspecies by Kuroda because of its geographical separation from the nominate species and its larger size.

The two specimens examined have a protoconch of about 4.5 opaque, yellow whorls with darker suture. The teleoconch begins to be disjunct after the first whorl. The adult specimen measures 5.7 mm in length and 3.7 mm in width and has 10 costae on the first whorl and six on the last.

***Cycloscala gazae* Kilburn, 1985**

Figs 22-23

*Cycloscala gazae* Kilburn, 1985:258, fig. 25. Type locality: Off Port Grosvenor, Transkei, South Africa, in 95-100 m.

**Material examined.** Loyalty Basin. BIOGEOCAL: sta. DW253, 21°32'S, 166°29'E, 310-315 m, 1 dd.

**Distribution.** Off the Transkei coast, South Africa, and the Loyalty Basin, 80- 310 m.

**Remarks.** The single specimen at my disposal is translucent white and 3.4 mm in length; has a teleoconch of almost three whorls, with about 13 weakly fluted, non-coronated costae on the first whorl and fourteen on the last; a light yellow protoconch of almost five whorls; and a round aperture. Although I have not examined the holotype of *Cycloscala gazae*, and although the specimen at hand is larger than the largest cited by Kilburn, his description and type figure match the characters of this specimen. The Loyalty Basin specimen considerably extends the known geographical distribution of this species.

*Cycloscala hyalina* (G. B. Sowerby II, 1844)

Figs 18-21, 36-37

*Scalaria hyalina* Sowerby II, 1844:85, pl. 32, figs 21, 22. Type locality: Catanuan Island, Luzon, Philippine Islands.

*Scalaria (Cycloscala) paucilobata* de Boury, 1911:329-330. Type locality: Lifou, Loyalty Islands (Fig. 37).

*Scalaria hyalina mokuoloense* Pilsbry, 1921:377. Type locality: Kaneohe Bay, Hawaii.

**Material examined.** Fiji. MUSORSTOM 10: sta. DW1314, 17°16.1'S, 178°14.8'E, 656-660 m, 2 dd. - Sta. DW1329, 17°19.3'S, 177°47.4'E, 102- 106 m, 1 dd. - Sta. DW1345, 17°14.9'S, 178°29.5'E, 660-663 m, 3 dd. - Sta. DW1381, 18°17.8'S, 177°54.4'E, 275-430 m, 1 dd. - Sta. DW1384, 18°18.5'S, 178°05.8'E, 260-305 m, 2 dd.sta. CP1363, 18°12.4'S, 178°33.0'E, 144-150 m, 1 dd. - Sta. CP1366, 18°12.4'S, 178°33.1'E, 149-168 m, 2 dd. - Sta. CP1369, 18°11.1'S, 178°23.4'E, 392-433 m, 1 dd. SUVA 2: sta. BS27, 18°08.4'S, 178°23.9'E, 63 m, 1 dd.

**Figures 1-12**

**1-7.** *Cycloscala echinaticosta* (d'Orbigny, 1842) **1.** *Scala electa* A. E. Verrill & Bush, 1900, Castle Harbour, Bermuda; in dredged spoil (H. G. Lee coll.). **2.** Boot Key Harbour, Marathon, Florida Keys (García coll. #23941). **3.** Varadero Beach, N. Matanzas Province, Cuba; dredged in 30 m (H. G. Lee coll.) **4.** W. of Santa Catalina I., Isla Providencia, Colombia; dredged in 26.7 m (García coll. # 19439). **5.** Bahama Islands; in drift (H.G. Lee coll.). **6.** Off Louisiana, U.S. A., at 27° 59.141'N, 91° 38.832'W; dredged in 91-65 m in coralline rubble with some sponges (García coll. # 23319). **7.** Bahama Islands; in drift (H.G.Lee coll.). **8-10.** *Cycloscala armata* n. sp. **8-9.** Reunion Island, 21°05'S, 55°12'E, 170-225 m [MD32, sta. DC56]. Holotype MNHN length 4.7 mm, width 2.6 mm. **10.** Loyalty Ridge. 20°42'S, 167°00'E, 282 m [MUSORSTOM 6, sta. DW399] (paratype). **11-12.** *Cycloscala crenulata* (Pease, 1867) Loyalty Islands, 20°56.8'S, 167°02.7E, 15-20 m [Atelier LIFOU, sta. 1455].

Loyalty Islands. Atelier LIFOU 2000: sta. 1413, 20°55.3'S, 167°05E, 3-10 m, 2 dd. - Sta. 1415, 20°47.1'S, 167°09.1'E, 3-7 m, 2 dd.- Sta. 1454, 20°56.65 S, 167°02.0'E, 15-18 m, 1 dd. - Sta. 1462, 20°47.1'S, 167°03.2'E, 70-120 m, 1 dd.

Loyalty Ridge. MUSORSTOM 6: sta. DW459, 21°01'S, 167°31'E, 425 m, 6 dd.

Marquesas Archipelago. MUSORSTOM 9: sta. DW1184, 8°49.3'S, 140°03.6'W, 23-30 m, 1 dd. - Sta. DW1206, 9°51'S, 139°09'W, 352-358 m, 2 dd. - Sta. 1208, 9°48.9'S, 139°09.5'W, 117 m, 1 dd. - Sta. DW1222, 9°44'S, 138°51'W, 340-352 m, 1 dd. - Sta. DW1288, 8°54'S, 139°38'W, 200-220 m, 2 dd. -Sta. DR1181, 8°45.5'S, 140°03.2'W, 102-130 m, 1 dd. - Sta. DR1200, 9°49.9'S, 139°08.9'W, 96-100 m, 2 dd. - DR1247, 10°34'S, 138°42'W, 1150-1250 m, 1 dd.

New Caledonia. BATHUS 1: sta. DW683, 20°35'S, 165°07'E, 380-400 m, 1 dd. - Sta. DW687, 20°35'S, 165°07'E, 408-440 m, 1 dd.

BATHUS 2: STA. CP755, 22°22'S, 166°14'E, 495 m, 1 dd. - Sta. CP760, 22°19'S, 166°11'E, 455 m, 1 dd.

BATHUS 3: sta. DW824, 23°19'S, 168°00'E, 601-608 m, 1 dd. - Sta. DW838, 23°01'S, 166°56'E, 400-402 m, 1 dd.

BERYX 11: sta. CP21, 24°44'S. 168°07'E, 430-450 m, 1 dd.

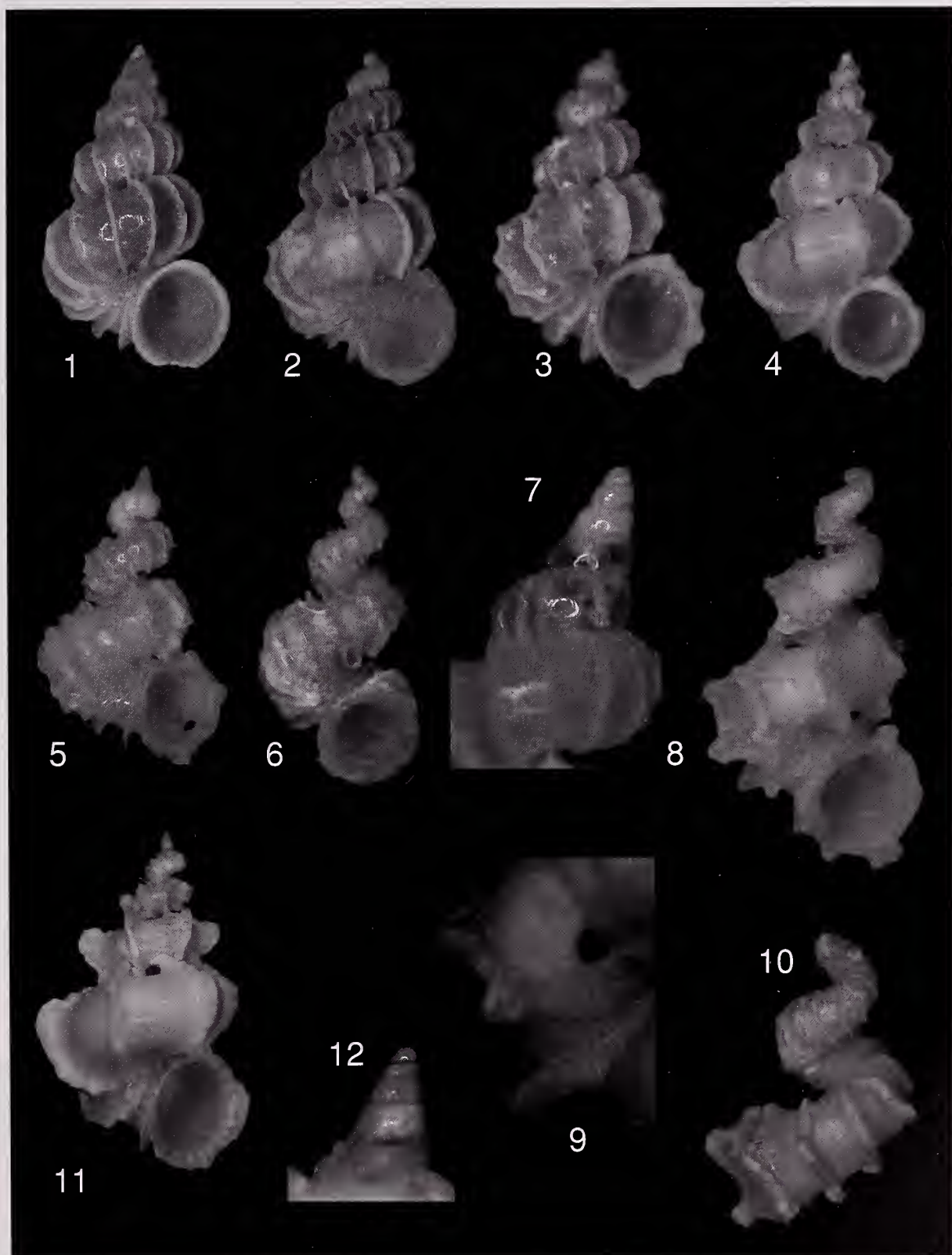
EXPEDITION MONTROUZIER: sta. 1237, 20°46.9'S, 165°13.8'E, 0-1 m. 1 dd. - Sta. 1250, 20°46.7'S, 165°13.7'E, 3-6 m, 31 dd.- Sta. 1251, 20°46.0'-20°46.5'S, 165°13'-165°14.5'E, 6-15 m, 2 dd (figs. 18-19). - Sta. 1264, 20°44.5'S, 165°15.9'E, 8 m, 15 dd. - Sta 1268. 20°45.2'S, 165°08'E. 9-11 m, 4 dd (fig. 20). Secteur de Nouméa: sta. 1355, 22°18.9'S, 166°26.6'E, 7-10 m, 1 dd. - Sta. 1367, 22°24.3'S, 166°20.7'E, 10 m, 6 dd.

Philippine Island. MUSORSTOM 3: sta. DR140, 11°43'N, 122°34'E, 93-99 m, 4 dd.

Reunion Island. MD32: sta. DC56, 21°05'S, 55°12'E, 170-225 m, 30 dd (fig. 21). - Sta. DC128, 20°51'S, 55°36'E, 280-340 m. 3 dd.

Tonga. BORDAU 2: sta. DW1607, 22°15'S, 175°23'W, 356-367 m, 1 dd.

Vanuatu. MUSORSTOM 8. Sta. CP1026, 17°50'S, 168°39'E, 437-504 m, 1 dd.



**Distribution.** From Hawaii and the Marquesas Islands to Natal, South Africa, mostly very shallow water to 1150 m.

**Remarks.** This species is the most common, widespread, and variable of the group. Some of its forms are similar to the western Atlantic *Cycloscala echinaticosta*. The single constant difference between the two is the color of the protoconch: white in the latter and amber or yellow in the former. Some shallow-water specimens of *C. echinaticosta* are less solute than any specimens of *C. hyalina* that I have studied, and some have a protoconch of 3.5 whorls.

The great variability of *Cycloscala hyalina* has created a number of synonyms. *Scalaria (Cycloscala) paucilobata* de Boury, 1911 (Fig. 37) is a synonym. *Scalaria hyalina mokuoloense* Pilsbry, 1921 has been synonymized by DuShane (1990: 3), who described it as having a protoconch of from 3 to 5 whorls. If this is the case, there is a parallel in protoconch variation between the Hawaiian population of *C. hyalina* and that of *Cycloscala echinaticosta* in Abaco, Bahama Islands. Kay (1979: 153) considered *C. h. mokuoloense* as valid and described its protoconch as having two minute whorls. In light of the consistency in protoconch whorl count of *C. hyalina* in large areas of the Indo-Pacific, the Hawaiian population warrants a closer look.

The type figure of *Solvaclathrus jacobiscala* Iredale, 1936 is identical to forms of *C. hyalina*, however, the author describes the species as having three glassy apical whorls. In his analysis, Iredale does not compare protoconchs. He differentiates his taxon from similar species by being more or less solute, by size, or by numbers of axial costae. These three parameters by themselves are inadequate for specific differentiation in *Cycloscala*, as infraspecific variations in these characters are common. I agree with Kilburn (1985: 257), that the

genus *Solvaclathrus* Iredale, 1936 is a junior synonym of *Cycloscala*.

***Cycloscala montrouzieri* n. sp.**

Figs 24-29.

**Type material.** Holotype MNHN length 2.0 mm, width 1.6 mm; 6 paratypes MNHN.

**Type locality.** New Caledonia, Secteur de Touho, Haut-Fond de Tié, 20°52.7'S, 165°19.5'E, 5-25 m [EXPEDITION MONTROUZIER, sta. 1271].

**Material examined.** New Caledonia. EXPEDITION MONTROUZIER Touho: sta. 1264, 20°44.5'S, 165°15.9'E, 8 m, 1 dd (paratype). - Sta. 1271, 20°52.7'S, 165°19.5'E, 5-25 m, 2 lv, 4 dd (holotype and 5 paratypes).

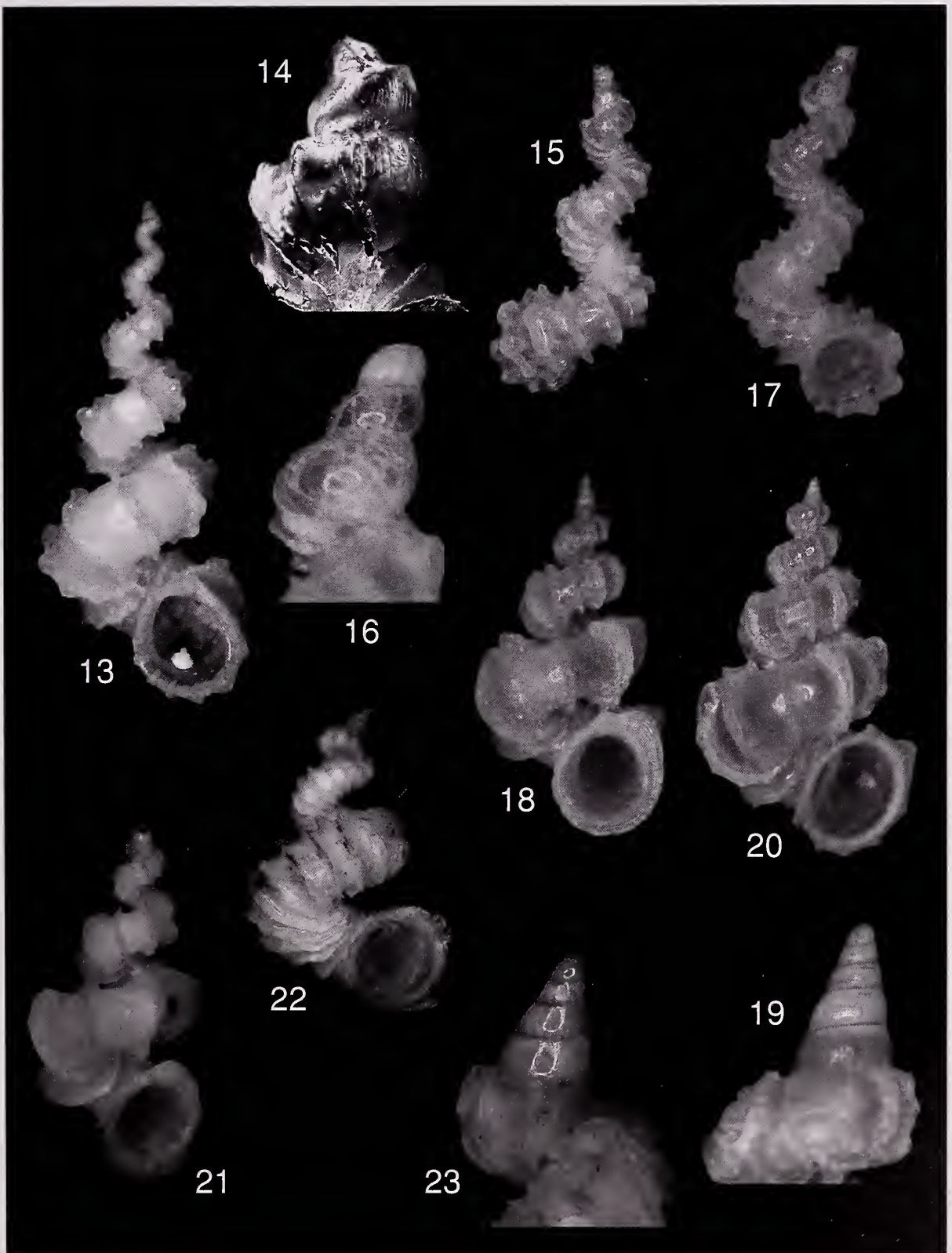
**Distribution.** New Caledonia, Secteur de Touho, 5-25 m.

**Description.** Holotype 2.0 mm in length, solid, widely turbinate (width/ length ratio 0.80). Protoconch (Fig. 27) peg-shaped, amber in coloration, translucent, with numerous axial striae. Teleoconch of about 2.5 shouldered whorls, round at periphery, rapidly increasing in width. Axial structure of erect, strongly scalloped costae, conspicuously hooked at shoulder; scalloping obsolete in umbilical area; edge of costae strongly bent abaperturally (Fig. 28); 12 costae on first whorl, diminishing to nine on last whorl. Interspaces smooth. Suture of first teleoconch whorl deep but closed; later whorls with only sporadic openings. Umbilicus deep but narrow. Aperture subcircular, thickened by labral varix; varix showing strong hook at shoulder. Shell milky-white. Operculum thin, transparent, colorless.

Paratypes similar to holotype. Largest paratype, presumably an adult, of about 3 whorls, measuring 2.6 mm in length and 2.5 mm in width. Last whorl with nine axial costae.

**Figures 13-23**

**13-17.** *Cycloscala sardellae* n. sp. **13-14.** Loyalty Island, Mepinyo, Santal Bay, 20°50.8'S, 167°09.7'E, 10-12 m [Atelier LIFOU, sta. 1445]. Holotype MNHN length 7.2 mm, width 3.1 mm. **15-17.** New Caledonia, 20°44.5'S, 165°15.9'E, 8 m [EXPEDITION MONTROUZIER, sta. 1264] (paratypes). Protoconch fig. 15. **18-21.** *Cycloscala hyalina* (G. B. Sowerby II, 1844). **18-19.** New Caledonia, Secteur de Touho, 20°46.0-20°46.5S, 165°13'-165°14.5'E, 6-15 m [EXPEDITION MONTROUZIER, sta. 1251]. **20.** New Caledonia, Secteur de Touho, 20°45.2'S, 165°08'E, 9-11 m [EXPEDITION MONTROUZIER, sta. 1268]. **21.** Reunion Island, 21°05'S, 55°12'E, 170-225 m [MD32, sta. DC56]. **22-23.** *Cycloscala gazae* Kilburn, 1985, Loyalty Basin, 21°32'S, 166°29'E, 310-315 m [BIOGEOCAL, sta. DW253].



**Remarks.** The widely turbinate shape and small size separates this species from most *Cycloscala*. It is closest to *Cycloscala crenulata*; however, this species has an opaque, yellow protoconch with darker suture, is larger, does not have strongly hooked costae, is not as widely turbinate, and does not have a strong bend at the edge of the costae. Compare a juvenile specimen of *C. crenulata* (Fig. 30) with the largest paratype of *C. montrouzieri* (Fig. 29). Both are of the same length.

**Etymology.** Named for Father ("Révérend Père") Xavier Montrouzier, a pioneer student of the fauna and flora of New Caledonia in the second half of the 19<sup>th</sup> century; and for whom *Expédition Montrouzier* was named.

***Cycloscala revoluta* (Hedley, 1899)**

Figs 31-34, 38

*Scalaria revoluta* Hedley, 1899:414, textfig. 7. Type locality: Funafuti, Ellice Island, Marshall Islands.

*Scalaria (Cycloscala) latedisjuncta* de Boury, 1911: 330. Type locality: Lifou, Loyalty Islands (Fig. 38).

**Material examined.** Loyalty Islands. Atelier LIFOU 2000: sta. 1419, 20°55.6'S, 167°04.5'E, 5 m, 1 dd. - Sta. 1435, 20°55.2'S, 167°00.7'E, 5-30 m, 2 lv. - Sta. 1448, 20°45.8'S, 167°01.65'E, 20 m, 1 dd. - Sta. 1450, 20°45.8'S, 167°01.65'E, 27-31 m, 1 lv, 1 dd. - Sta. 1455, 20°56.8'S, 167°02.7'E, 15-20 m, 1 dd.

New Caledonia. EXPEDITION MONTROUZIER Touho: sta. 1250, 20°46.7'S, 165°13.7'E, 3-6 m, 2 dd. - Sta. 1256, 20°45.0'S, 165°09.8'E, 15-20 m, 1 dd. - Sta. 1270, 20°45'S, 165°16.5'E, 10-35 m, 1 dd. - Sta. 1271, 20°52.7'S, 165°19.5'E, 5-25 m, 2 dd.

**Distribution.** Hawaii, Marshall Islands, Loyalty Islands, New Caledonia, Red Sea, 30 m (live), 5-150 m (shell only).

**Remarks.** This species is very similar to some forms of *Cycloscala hyalina* and, indeed, it may

well be the same species. However, I am treating this taxon as a valid species because identical forms have been found in the Miocene marls in Palau (Kay, 1979: 156) and because both taxa have been collected sympatrically in the Loyalty Islands and New Caledonia. All of the specimens at my disposal were collected in relatively shallow water. *Scalaria (Cycloscala) latedisjuncta* de Boury, 1911 (Fig. 38) is a synonym.

The distinct differentiating factor between *Cycloscala hyalina* and *C. revoluta* is the strong, conspicuous hooked shoulder of the latter. *Cycloscala revoluta* also has stronger crenulations, is always highly solute and seems to have a less hyaline, heavier shell. Some forms of *C. hyalina* have an insinuation of a shoulder spine, however, I have not seen a typical *C. hyalina*, i.e., the less disjunct form shown in Sowerby's type figure (Fig. 36), which has a strongly hooked shoulder.

***Cycloscala sardellae* n. sp.**

Figs 13-17

**Type material.** Holotype MNHN length 7.2 mm, width 3.1 mm: 2 paratypes MNHN.

**Type locality.** Loyalty Islands, Lifou, Santal Bay, Mepinyo, 20°50.8'S, 167°09.7'E, 10-12 m [Atelier LIFOU, sta. 1445].

**Material examined.** Loyalty Islands. Atelier LIFOU: sta. 1445, 20°50.8'S, 167°09.7'E, 10-12 m. 1 dd (holotype).

New Caledonia. - EXPEDITION MONTROUZIER: sta. 1264, 20°44.5'S, 165°15.9'E, 8 m, 2 dd (paratypes).

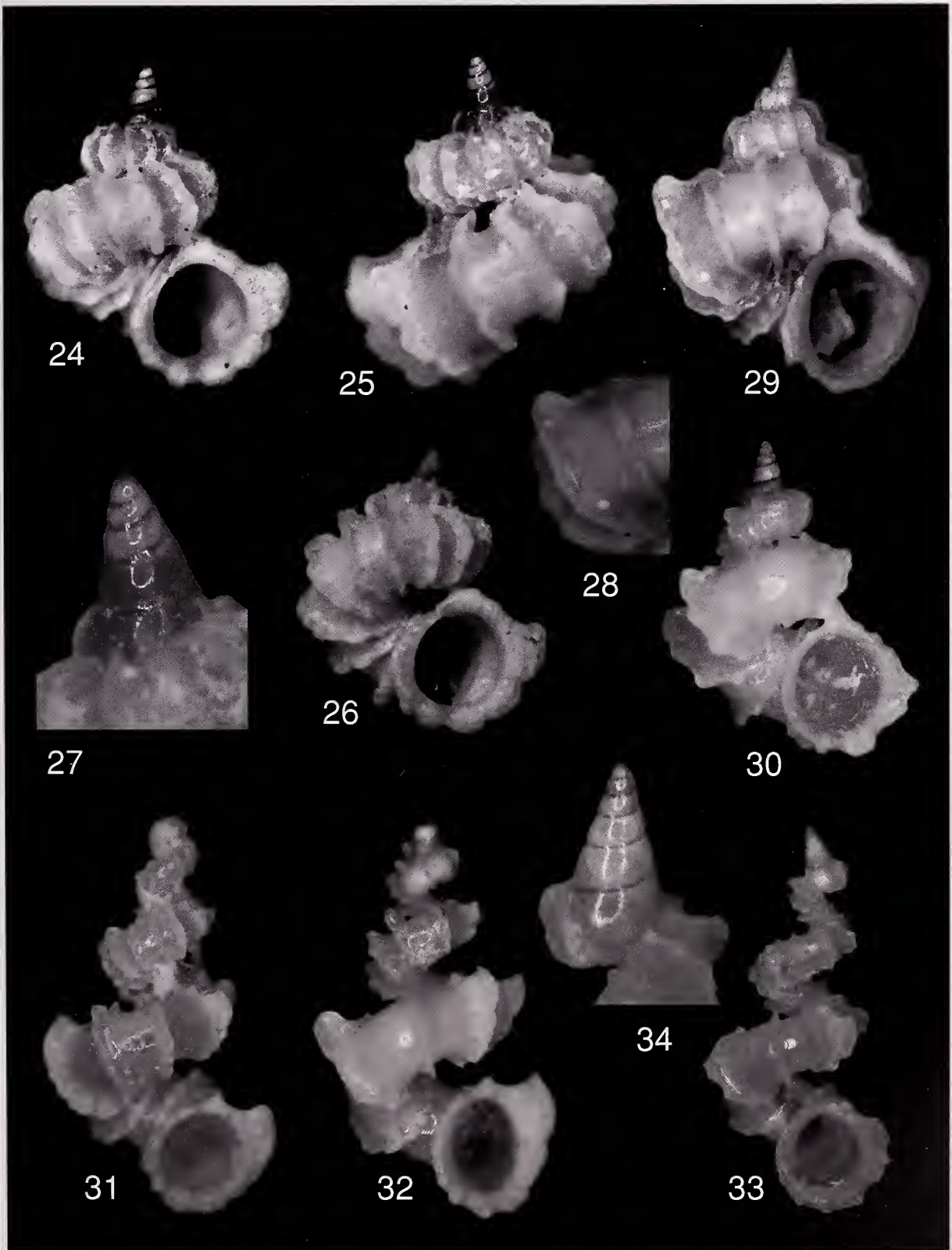
**Distribution.** New Caledonia and the Loyalty Islands, 8-12 m (shells only).

**Description.** Holotype 7.2 mm in length, elongate-turbinate (width/length ratio 0.43). Protoconch slightly tilted from axis, damaged, remaining two whorls milky-white, strongly convex, with well-delineated suture. Photographs under SEM show axial striae (Fig. 14). Teleoconch of approximately 5.5 markedly

**Figures 24-34**

**24-29.** *Cycloscala montrouzieri* n. sp. **24-28.** New Caledonia, Secteur de Touho, Haut-Fond de Tié, 20°52.7'S, 165°19.5'E, 5-25 m [EXPEDITION MONTROUZIER, sta. 1271]. Holotype MNHN length 2.0 mm, width 1.6 mm. **29.** Largest paratype from same locality, length 2.6 mm, width, 2.5 mm. **30.** *Cycloscala crenulata* (Pease, 1867), New Caledonia, 20°50.4'S, 165°22.8'E, 20 m [EXPEDITION MONTROUZIER, sta 1273]. Juvenile, length 2.6 mm, width 1.5 mm. **31-34.** *Cycloscala revoluta* (Hedley, 1899), Loyalty Islands, Lifou, Baie du Santal. **31.** 20°55.6'S, 167°04.5'E, 5 m [Atelier LIFOU: sta. 1419]. **32.** 20°55.2'S, 167°00.7'E, 5-30 m [Atelier LIFOU, sta. 1435]. **33-34.** 20°45.8'S, 167°01.65E, 27-31 m [Atelier LIFOU, sta 1450.]. Subadult.



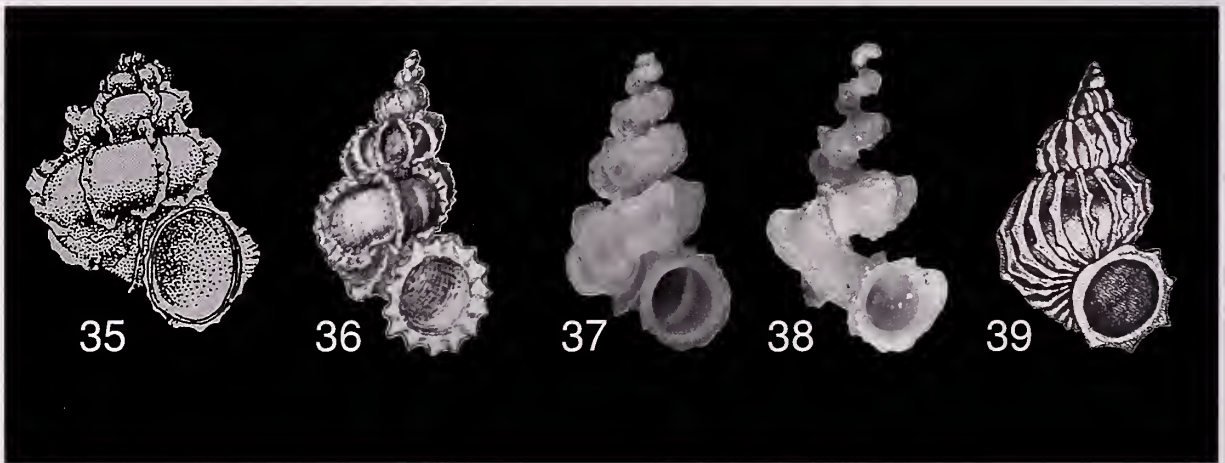


disjunct, shouldered whorls. Axial sculpture of erect, evenly spaced, strongly denticulate costae; some costae almost rectangular in shape, resembling a cog wheel; denticles becoming obsolete at umbilical area, about eight per costa; seven costae on last whorl; edge of costae with a slight abapertural bend. Space between costae smooth, shiny. Aperture circular. Shell milky-white. Operculum unknown.

**Remarks.** The white, strongly convex protoconch of *Cycloscala sardellae* (Figs. 14 and 16) differs from all other known protoconchs of Indo-Pacific *Cycloscala* species, which have almost straight sides and are amber or yellow in color. Although the western Atlantic *Cycloscala echinaticosta* does have a whitish protoconch, its sides are also almost

straight. The new species is closest to *Cycloscala armata* n. sp., which is smaller, has eight instead of four denticles on the axial costae, a conspicuous fold at the edge of the costae, including the edge of the denticles, and a more conical, less attenuated shape. Although some of the more heavily scalloped, subadult forms of *Cycloscala revoluta* (Fig. 33) resemble *C. sardellae*, the costae of the former are hooked at the shoulder, and the crenulations are weaker, unevenly distributed, and of uneven strength.

**Etymology.** At the request of Philippe Bouchet, the present elegant new species is named for Ms Gina Sardella-Sadiki, assistant to the Program Director of the Total Foundation for Biodiversity and the Sea, which generously supported the LIFOU 2000 expedition.



**Figures 35-39**

35. *Cycloscala crenulata dragonella* Kuroda, 1960, type figure. 36. *Scalaria hyalina* G. B. Sowerby II, 1844, type figure. 37. *Scalaria paucilobata* de Boury, 1911, holotype MNHN. 38. *Scalaria latedisjuncta* de Boury, 1911, holotype ZMB Moll. 103.079. 39. *Scalaria echinaticosta* d'Orbigny, 1942, type figure.

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## REFERENCES

- Abbott, R. T. 1974. American Seashells. Second edition. Van Nostrand Reinhold, New York, 663 pp.
- Bouchet, P. 1994. Atelier biodiversité récifale, Expédition Montrouzier. Touho – Koumac, Nouvelle-Calédonie, 23 août - 5 novembre 1993. *Centre ORSTOM de Nouméa, Rapport de missions, Sciences de la Terre, Biologie Marine*, 24: 1-63.
- Bouchet, P., Héros, V., Le Goff, A., Lozouet P., & Maestrati, P. 2001. Atelier Biodiversité LIFOU 2000. Grottes et récifs. *Report to the Total Foundation*, Paris, 110 pp.
- Clench, W. J., & Turner, R. D. 1951. The genus *Epitonium* in the western Atlantic. Part I. *Johnsonia* 2 (30): 249-327.
- Dall, W. H. 1889. Reports on the results of dredgings...by the U.S. coast survey steamer "Blake," ...29. Report on the mollusca. Part II. Gastropoda and Scaphopoda. *Bulletin of the Museum of Comparative Zoology. Harvard* 18: 1-492.
- de Boury, M. E. 1909. Catalogue des sous-genres de Scalidae. *Journal de Conchyliologie* 57: 255-258.
- de Boury, M. E. 1911. Diagnoses de Scalariidae nouveaux appartenant aux sous-genres *Cycloscala* et *Nodiscala*. *Bulletin du Muséum national d'Histoire naturelle* 17: 329-331.
- DuShane, H. 1990. Hawaiian Epitoniidae. *Hawaiian Shell news Supplement* 1: 1-17.
- Forest, J. 1989. Report on the MUSORSTOM 3 Expedition to the Philippines (May 21<sup>st</sup> – June 7<sup>th</sup> 1985). In: J. Forest (ed.), Résultats des Campagnes MUSORSTOM, volume 4. *Mémoires du Muséum National d'Histoire Naturelle*, ser. A, 143: 9-23.
- García, E. F. 2001. Three new deep-water epitoniid (Mollusca: Gastropoda) species from the southern Philippines. *Novapex* 2 (3) 109-114.
- García, E. F. 2003. New records of Indo-Pacific Epitoniidae (Mollusca: Gastropoda) with the description of nineteen new species. *Novapex* 4 (HS): 1-22.
- García, E.F. 2004. New records of *Opalia*-like mollusks (Gastropoda: Epitoniidae) from the Indo-Pacific, with the descriptions of fourteen new species. *Novapex* 5 (1): 1-18.
- Hedley, C. A. 1899. The Mollusca of Funafuti. *Memoires of the Australian Museum* 3: 395-510.
- Jousseume, F. 1912. Faune malacologique de la Mer Rouge (Scalidae). *Mémoires de la Société Zoologique de France* 24 (3-4): 180-246.
- Kay, E. A. 1979. *Hawaiian marine shells*. Reef and shore fauna of Hawaii. Section 4. Mollusca. B. P. Bishop Museum Special Publications 64 (4), 652 pp.
- Kilburn, R. N. 1985. The family Epitoniidae (Mollusca: Gastropoda) in southern Africa and Mozambique. *Annals of the Natal Museum* 27 (1): 239-337.
- Nakayama, T. 2000. Description of a new subgenus, fourteen new species, and three substituted names of epitoniids from Japan. *Venus* 59 (4): 277- 292.
- Nakayama, T. 2003. A review of northwest Pacific epitoniids (Gastropoda: Epitoniidae). *Monographs of Marine Mollusca* No. 6, 143 pp, 20 pls.
- Pease, W. H. 1867. Descriptions of sixty-five new species of marine gasteropoda inhabiting Polynesia. *American Journal of Conchology*, 3: 271- 297.
- Pilsbry, H.A. 1917-1921. Marine Mollusks of Hawaii. *Proceedings of the Academy of Natural Sciences of Philadelphia* 72: 296-382.
- Redfern, C. 2001. *Bahamian Seashells*. A thousand species from Abaco, Bahamas. Bahamianseashells.com, Inc., Boca Raton, 280 pp.
- Richer de Forges, B. 1990. Explorations for bathyal fauna in the New Caledonian economic zone. In: A. Crosnier (ed.), Résultats des Campagnes MUSORSTOM, volume 6. *Mémoires du Muséum National d'Histoire Naturelle*, ser. A, 145: 9-54.
- Richer de Forges, B. 1993. Campagnes d'exploration de la faune bathyale faites depuis mai 1989 dans la zone économique de la Nouvelle-Calédonie. Listes des stations. In: A. Crosnier (ed.), Résultats des Campagnes MUSORSTOM, volume 10. *Mémoires du Muséum National d'Histoire Naturelle* 156: 27-32.
- Richer de Forges, B. & Chevillon, C. 1996. Les campagnes d'échantillonnage du benthos bathyal en Nouvelle-Calédonie, en 1993 et 1994 (BATHUS 1 à 4, SMIB 8 et HALIPRO 1). In: A. Crosnier (ed.), Résultats des Campagnes MUSORSTOM, volume 15. *Mémoires du Muséum National d'Histoire Naturelle* 168: 33-53.
- Richer de Forges, B., Faliex, E. & Menou, J. L. 1996. La campagne MUSORSTOM 8 dans l'archipel de Vanuatu. Compte rendu et liste des stations. In: A. Crosnier (ed.), Résultats des Campagnes MUSORSTOM, volume 15. *Mémoires du Muséum National d'Histoire Naturelle* 168: 9-32.
- Richer de Forges, B., Poupin, J., & Laboute, P. 1999. La campagne MUSORSTOM 9 dans l'archipel des îles Marquises (Polynésie française). Compte rendu et liste des stations. In: A. Crosnier (ed.), Résultats des Campagnes MUSORSTOM, volume 20. *Mémoires du Muséum National d'Histoire Naturelle* 180: 9-29.

- Richer de Forges, B., Newell, P., Schlacher-Hoenlinger, M., T. Schlacher, Nating, D., Cesa, F., & Bouchet, P. 2000b. La campagne MUSORSTOM 10 dans l'archipel des îles Fidji. Compte rendu et liste des stations. In: A. Crosnier (ed.), Résultats des Campagnes MUSORSTOM, volume 21. *Mémoires du Muséum National d'Histoire Naturelle* 184: 9-23.
- Robertson, R. 1994. Protoconch size variation along depth gradients in a planktotrophic *Epitonium*. *The Nautilus* 107 (4): 107-112.
- Sowerby, G. B. II. 1844. Monograph of the genus *Scalaria*. *Thesaurus Conchyliorum* 4: 83-108.
- Verrill, A. E., & Bush, K. J. 1900. Additions to the marine mollusca of the Bermudas. *Transactions of the Connecticut Academy of Arts and Sciences* 10: 513-544.
- Weil, A., Brown, L., & Neville, B. 1999. *The wentletrap book*. Evolver, Rome, 244 pp.